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Abstract
Three hundred eighty-four crossbred heifers [initial body weight (BW) = 582 ± 42 lb] were used in a completely randomized design, 81-day receiving and growing study, with a 2 × 2 factorial arrangement of four dietary treatments. The objective was to evaluate the effect of feeding corn grain and corn silage from Enogen corn hybrids (EC; Syngenta Seeds, LLC., Downers Grove, IL) or conventional corn hybrids (CON) in diets containing either wet distillers grain (WDG; ICM Biofuels, St. Joseph, MO) or Sweet Bran [proprietary wet corn gluten feed (WCGF); Cargill Animal Nutrition, Blair, NE]. Experimental unit was pen. There were eight pens per treatment, with 12 heifers stratified by weight to each pen. Experimental diets were formulated to contain 30% WDG or 30% WCGF on a dry matter (DM) basis and provide 51 megacalories of net energy for gain per 100 lb of DM daily. All diets were fed once daily for *ad libitum* consumption. No corn source × coproduct interactions ($P > 0.10$) were observed for performance or fecal starch analysis, with the exceptions of DM intake ($P < 0.01$) and gain to feed ratio ($P = 0.01$) at day 14. An effect of coproduct was observed at day 64, with heifers fed WDG having greater ($P < 0.03$) average daily gain (ADG) than heifers fed WCGF. Effect of coproduct on DM intake or gain to feed ratio was not different ($P > 0.05$) after day 14. Heifers fed EC had greater ($P < 0.01$) ADG at days 28 and 56 than heifers fed CON, but gain to feed ratio was not different ($P > 0.13$) between corn sources after day 28. Starch concentration of fecal DM was greater ($P < 0.02$) in CON heifers than EC heifers. Results indicate EC when fed with WCGF or WDG did not enhance growth performance of growing heifers, possibly due to similar dietary net energy densities fed in all diets.

Introduction
Recent research conducted at the Kansas State University Beef Stocker Unit suggested average daily gain (ADG) of growing cattle was 5% better by feeding diets containing Enogen corn as corn silage compared to silage with conventional corn hybrids. Growing cattle eating Enogen corn as dry rolled corn had a 2.4% better gain to feed ratio than

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growing cattle eating conventional corn hybrids as whole corn. Corn coproducts are widely used in the cattle feeding industry, but an evaluation of Enogen corn hybrids fed as dry rolled corn and corn silage in diets containing corn coproducts fed to growing cattle has not been conducted.

Experimental Procedures

Five hundred twenty-two crossbred heifers [initial body weight (BW) = 582 ± 67 lb] of Wyoming and Nebraska origin were loaded on trucks at a ranch 5 miles north of Stapleton, NE, and shipped 360 miles to the Kansas State University Beef Stocker Unit. Of these cattle, 384 heifers (initial BW = 582 ± 42) were used in a completely randomized design, with a 2 × 2 factorial arrangement of four dietary treatments. Experimental unit was pen. Cattle were fed in an outdoor receiving facility containing 32 soil-surfaced pens, each with an adjoining 30-ft concrete bunk attached to a 11.8-ft apron. All pens were equipped with automatic tank waterers (Lil' Spring 3000; Miraco Livestock Water Systems, Grinnell, IA), and daily total mixed rations were delivered using a Roto-Mix feed wagon (model 414-14B, Dodge City, KS). On arrival (day -2), cattle were individually weighed and assigned a visual ear tag, while being assessed for pre-existing tags, physical injuries, or morbidity. Before processing and allocation to experimental pens on day 0, cattle were allowed *ad libitum* access to long-stem prairie hay and water. Because heifers had an extensive preconditioning and vaccination history, they were not vaccinated on arrival. The preconditioning program from previous ownership included an initial vaccination and booster with each of the following: Bovishield Gold FP5, One Shot, and UltraBac 8 (Zoetis, Parsippany, NJ). On day 0, heifers were individually weighed (model T20, Te Pari Products, Burnsville, MN), identified with visual and electronic identification ear tags, and drenched with an oral dewormer (Synanthic, Boehringer Ingelheim Animal Health, Duluth, GA). Heifers were stratified by day -2 body weight to one of 32 pens, with eight pens per dietary treatment and 12 heifers per pen. Pen weights were recorded on day 0 and used for initial BW weight in performance calculations.

Dietary treatments (Table 1) were formulated to contain 30% wet distillers grain (WDG; ICM Biofuels, St. Joseph, MO) or 30% wet corn gluten feed (WCGF; Sweet Bran, Cargill Animal Nutrition, Blair, NE) on a dry matter (DM) basis and provide 51 megacalories (Mcal) of net energy for gain (NE_g) per 100 lb of DM daily. Main effects were corn source that included conventional corn, dry rolled (CON) or Enogen corn, dry rolled (EC; Syngenta Seeds, LLC, Downers Grove, IL) and coproduct that included WCGF or WDG. All corn grain was dry rolled by a commercial feed mill (Key Feeds, Clay Center, KS). All pens had *ad libitum* access to diets throughout the study. Bunks were visually assessed, and feed refusals were estimated each morning at 7:00 a.m. Daily feed refusals were targeted at 20 lb per pen. A scale (Rice Lake Weighing Systems, Rice Lake, WI) was used to record pen weights on day 0, 14, 28, 42, 56, 64, and 81. Individual BW were measured and a fecal grab sample for starch determination was collected on day 42. Final growth performance was calculated for each period from day 0 to 81. Treatment diets were provided from day 0 through day 64. Then, to minimize differences in gastrointestinal-tract fill all pens were limit-fed the CON/WCGF diet at 2.2% of day 64 body weight daily from day 64 to 81. Feed samples were collected on a weekly basis throughout the study and frozen at -4°F. Upon study completion, samples were thawed, composited, refrozen, and taken to a commercial laboratory (SDK Laboratories, Hutchinson, KS) for nutrient analysis.

Results and Discussion

Composition and nutrient analysis of experimental diets are presented in Table 1, and analysis of corn silages and corn coproducts are presented in Table 2. Growth performance data are reported in Table 3. With the exceptions of minor interactions for DM intake and gain to feed ratio between days 0 and 14, no interactions between main effects of corn source and coproduct were noted for this study. In our 81-day growing trial there were significant corn source × coproduct interactions detected from days 0 through 14 for DM intake ($P < 0.01$) and gain to feed ratio ($P = 0.05$). While heifers consuming CON/WCGF had lower ($P < 0.01$) DM intake than EC heifers, heifers consuming CON/WDG had greater ($P < 0.01$) DM intake than EC heifers. There was a tendency ($P = 0.054$) for CON/WCGF heifers to have a greater gain to feed ratio compared to EC heifers.

There were main effects ($P \leq 0.03$) of coproduct for BW and ADG at the time provision of treatment diets concluded (day 64) as well as after the gastrointestinal tract fill equilibration period (day 81); heifers fed WDG had greater BW and ADG than heifers fed WCGF. Because DM intake was not markedly affected by coproduct, heifers consuming WDG also tended to have a better gain to feed ratio at day 64 ($P = 0.06$) as well as a numerically better gain to feed ratio at day 81 than heifers fed WCGF. At day 14, heifers fed WCGF had a greater ($P < 0.05$) gain to feed ratio than those fed WDG, which resulted from greater DM intake for heifers fed WDG. Heifers consuming EC had greater ($P \leq 0.03$) BW and ADG gain at day 28 and day 56 compared to heifers fed CON. At day 28, heifers fed EC also had a better ($P < 0.01$) gain to feed ratio than those fed CON, with a similar tendency ($P = 0.06$) observed for DM intake. No differences between corn sources were observed for gain to feed ratio or DM intake after day 28. Main effect of corn source for net energy concentration was not observed in this study, but WDG diets had numerically greater net energy concentration calculated from animal performance than WCGF diets. The EC heifers had less starch in the feces ($P < 0.02$) than CON heifers, but there was no main effect detected for coproduct.

Implications

Our results revealed no effect of replacing conventional corn grain and silage with Enogen corn grain and silage on the growth performance of growing cattle, but diets containing WDG resulted in better gain to feed ratio and ADG in growing heifers compared to diets containing WCGF.

Acknowledgments

Syngenta Seeds, LLC, Downers Grove, IL.

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Table 1. Composition and nutrient analysis of study diets

		Corn source[1]			
		CON		EC	
		Coproduct[2]			
Ingredient, % of total DM[3]	**GFE[4]**	**WCGF**	**WDG**	**WCGF**	**WDG**
Conventional corn hybrids	21.0	21.0	19.0	0.0	0.0
Enogen corn hybrids	0.0	0.0	0.0	21.0	19.0
Conventional corn silage	20.0	20.0	20.0	0.0	0.0
Enogen corn silage	0.0	0.0	0.0	20.0	20.0
WCGF	30.0	30.0	0.0	30.0	0.0
WDG	0.0	0.0	30.0	0.0	30.0
Long-stem alfalfa hay	12.0	12.0	13.0	12.0	13.0
Chopped prairie hay	12.0	12.0	13.0	12.0	13.0
Supplement	5.0	5.0	5.0	5.0	5.0
Nutrient composition					
DM, % as fed	72.48	55.56	48.55	58.12	50.30
Crude protein	14.38	14.06	16.48	14.01	15.40
Starch	28.15	23.31	19.23	23.16	20.77
Neutral detergent fiber	27.75	31.27	32.49	31.25	32.33
Acid detergent fiber	11.56	15.20	15.86	15.07	15.72
Calcium	0.83	0.75	0.86	0.76	0.83
Phosphorus	0.57	0.50	0.56	0.50	0.53

[1] CON = Conventional corn hybrids, dry rolled. EC = Enogen corn hybrids, dry rolled (Syngenta Seeds, LLC, Downers Grove, IL).
[2] WCGF = wet corn gluten feed (Sweet Bran, Cargill Animal Nutrition, Blair, NE). WDG = wet distillers grain (ICM Biofuels, St. Joseph, MO).
[3] DM = dry matter.
[4] GFE = gastrointestinal tract fill equilibration diet fed from days 64 to 81 to all cattle.

Table 2. Analysis of nutrients in corn silages and corn coproducts fed

	Ingredient[1]			
Item, % of total DM[2]	**CS**	**ES**	**WCGF**	**WDG**
Nutrient composition				
DM,[2] % as fed	27.2 ± 2.0	31.6 ± 2.6	61.1 ± 2.5	37.5 ± 1.2
Crude protein	9.5 ± 0.9	8.7 ± 0.5	22.4 ± 0.5	28.1 ± 1.0
Starch	23.5 ± 4.2	27.5 ± 3.6	---	---
Acid detergent fiber	21.7 ± 2.3	20.4 ± 1.5	8.5 ± 0.6	9.7 ± 2.1
Neutral detergent fiber	38.4 ± 3.5	36.2 ± 2.1	30.5 ± 1.8	33.1 ± 5.1
Calcium	0.27 ± 0.03	0.23 ± 0.03	0.05 ± 0.02	0.09 ± 0.03
Phosphorus	0.21 ± 0.03	0.19 ± 0.01	1.06 ± 0.07	1.15 ± 0.14

[1] CS = conventional corn hybrid silage. ES = Enogen corn hybrid silage (Syngenta Seeds, LLC., Downers Grove, IL). WCGF = wet corn gluten feed (Sweet Bran, Cargill Animal Nutrition, Blair, NE). WDG = wet distillers grain (ICM Biofuels, St. Joseph, MO).
[2]DM = dry matter.

Table 3. Effect of Enogen corn hybrids or conventional corn hybrids in diets containing corn coproducts on growth performance and fecal starch output

	Corn source[1]							
	CON		EC					
	Coproduct[2]					*P*-value[4]		
Item	**WCGF**	**WDG**	**WCGF**	**WDG**	**SE[3]**	**S**	**CP**	**S × CP**
Number of pens	8	8	8	8				
Number of animals	96	96	96	96				
BW,[5] lb								
Day 0	549.0	551.4	548.7	546.7	1.94	0.21	0.95	0.26
Day 81, after GFE[6]	798.1	815.0	806.2	813.9	5.71	0.49	0.03	0.48
ADG,[7] lb/d	3.06	3.26	3.17	3.31	0.07	0.25	0.03	0.72
DM intake, lb/d	20.02	20.11	20.26	20.53	0.31	0.30	0.55	0.78
Gain to feed ratio, lb/lb	0.154	0.162	0.157	0.161	0.01	0.78	0.12	0.68
NE_m, Mcal/lb DM[8]	0.71	0.73	0.72	0.73	0.01	0.96	0.16	0.54
NE_g, Mcal/lb DM[8]	0.44	0.46	0.44	0.45	0.01	0.86	0.17	0.49
Fecal starch, % of total DM	15.2	17.1	13.5	11.4	1.35	0.02	0.91	0.15

[1] CON = Conventional corn hybrids, dry rolled. EC = Enogen corn hybrids, dry rolled (Syngenta Seeds, LLC, Downers Grove, IL). The diets were formulated to contain 51 megacalories of net energy for gain per 100 lb of dry matter daily.
[2] WCGF = wet corn gluten feed (Sweet Bran, Cargill Animal Nutrition, Blair, NE). WDG = wet distillers grain (ICM Biofuels, St. Joseph, MO).
[3]Standard error.
[4] S = corn source. CP = coproduct.
[5]BW = body weight.
[6] GFE = Gastrointestinal tract fill equilibration period. GFE diet was limit-fed at 2.2% of day 64 body weight daily on a dry matter basis from days 64 to 81.
[7]ADG = average daily gain.
[8] NE_m = megacalories (Mcal) of net energy for maintenance per lb of DM. NE_g = Mcal of net energy for gain per lb of DM. Net energy calculations of day 0 to 81 from (Galyean, 2021) based on NRC (1996) requirements.